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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/945,535
Filing Date: August 30, 2001
Appellant(s): AHN ET AL.

David Suhl
SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 22 September 2008 appealing from the Office action mailed 21 April 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows: Claims 8-9 are rejected under 35 U.S.C. § 103(1) as being unpatentable over Ma et al. (U.S. Patent No. 6,207,589) in view of Park (U.S. Patent No. 5,795,808) and Yano et al. (U.S. Patent No. 5,810,923) as applied to claims 1-2 and 6-7 above, and further in view of Moise et al. (U.S. Patent No. 6,211,035).

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,207,586	Ma et al.	3-2001
5,795,808	Park	8-1998
5,810,923	Yano et al.	9-1998
6,211,035	Moise et al.	4-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589) in view of **Park** (USPN 5,795,808) and **Yano et al** (USPN 5,810,923).

Regarding claim 1, **Ma et al** disclose a method of forming a gate oxide on a transistor body region, comprising:

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting a single crystal semiconductor portion of the body region **52** [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention," and therefore is absent in

others], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region, wherein the metal oxide is amorphous [see col. 3, lines 1-4 and 44-56].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 and 200°C; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because it has been held that simple substitution of one known method for another to obtain predictable results is obvious. See *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (2007). While the deposition temperature disclosed by **Park** is slightly higher than claimed, these claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the

deposition temperature to provide for processing limitations, including reduction of heat loads and the prevention of damage to other elements of the device due to exposure to higher heat.

Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

Regarding claim 2, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein the metal layer is zirconium [see **Ma et al**, col. 2, line 67; see also **Park**, col. 4, line 25].

Regarding claim 6, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein oxidizing the metal layer includes oxidizing at a temperature of approximately 400ºC [see **Yano et al**, col. 10, lines 1-8].

Regarding claim 7, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1, furthermore wherein oxidizing the metal layer includes oxidizing with atomic oxygen [see **Yano et al**, col. 21, lines 35-36].

Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Ma et al** (USPN 6,207,589) in view of **Park** (USPN 5,795,808) and **Yano et al** (USPN 5,810,923) as applied to claims 1, 2, 6 and 7 above, and further in view of **Moise et al** (USPN 6,211,035).

Regarding claim 8, the prior art of **Ma et al**, **Park** and **Yano et al** teach the method of claim 1 as described above. None of **Ma et al**, **Park** and **Yano et al** teach oxidizing in a krypton/oxygen mixed plasma. **Ma et al** teach annealing in an oxygen plasma containing inert gases such as argon and nitrogen [see col. 6, lines 64-65]. **Moise et al** teach oxidizing a metal layer with inert gases such as argon and krypton [see col. 12, lines 23-24]. It would have been obvious to one of ordinary skill in the art at the time of invention to use krypton because it has been held that simple substitution of one known element for another to obtain predictable results is obvious. See *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (2007).

Regarding claim 9, **Ma et al** disclose a method of forming a gate oxide on a transistor body region, comprising:

evaporation depositing [see col. 2, lines 54-55] a substantially amorphous and substantially pure single metal layer [see col. 2, lines 65-67; see also col. 3, lines 53-55 and 60-62; finally, see col. 5, lines 65-66, wherein the trivalent metal content "is in the range of approximately 0 to 50%"] directly contacting a single crystal semiconductor portion of the body region [see col. 2, lines 11-14, wherein the barrier layer is present in "some aspects of the invention"], the metal being chosen from the group IVB elements of the periodic table, specifically zirconium; and

oxidizing the metal layer to form a metal oxide layer directly contacting the body region [see col. 3, lines 1-4].

Ma et al do not disclose wherein the evaporation deposition method is electron beam evaporation at a temperature between 150 to 200°C, nor that the metal layer is oxidized using a

krypton/oxygen mixed plasma; furthermore, **Ma et al** is silent as to the surface roughness or smoothness. **Park** teaches depositing a metal layer, specifically zirconium (as in both **Ma et al** and the instant claims), by either sputtering or electron beam deposition [see col. 4, lines 22-27]. It would have been obvious to one of ordinary skill in the art at the time of invention to use e-beam evaporation deposition because it has been held that simple substitution of one known method for another to obtain predictable results is obvious. See *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (2007). While the deposition temperature disclosed by **Park** is slightly higher than claimed, these claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the deposition temperature provides unexpected results in the layer produced. One of ordinary skill in the art would be motivated to optimize the deposition temperature to provide for processing limitations, including reduction of heat loads and the prevention of damage to other elements of the device due to exposure to higher heat.

Moise et al teach oxidizing a metal layer with inert gases such as argon and krypton [see col. 12, lines 23-24]. It would have been obvious to one of ordinary skill in the art at the time of invention to use krypton because it has been held that simple substitution of one known element for

another to obtain predictable results is obvious. See *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (2007).

Furthermore, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, but also teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. Note that where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). One of ordinary skill in the art would look to one such as **Yano et al** to modify the teachings of **Ma et al** and **Park**, such that one of ordinary skill would expect, as per the teachings of **Yano et al**, that the processes of **Ma et al** and **Park** would yield a surface roughness as taught by **Yano et al**.

(10) Response to Argument

On page 10 of the Appeal Brief, Appellants argue that "Ma does not fairly suggest the use of pure metals … Appellant submits that the cited Ma reference would be clearly understood by one of ordinary skill in the art to strongly suggest the use of heavily doped metal layers to prevent crystallization of the metal during anneal." The Examiner, as before, concedes that **Ma et al** teach that a preferable metal film contains the trivalent metal dopant. However, **Ma et al** clearly contemplate a scenario where the metal film is undoped; the Examiner points to **Ma et al**, column 5, lines 65-66, wherein "[t]he percentage of Al, or other trivalent metal, in film **56** is in the range of

approximately 0 to 50%." Regardless of the teaching of a preference for a heavily doped metal layer, **Ma et al** have provided an explicit teaching of a substantially pure single metal layer. While Appellants go on, on page 11 of the Appeal Brief, to number the reasons **Ma et al** teach that the doped metal layer is preferred, including improved IV characteristics, leakage currents, time-dependent dielectric breakdown voltages, etc., and allege that the figures show that low doping levels have worse results, the Examiner contends that only Fig. 2 directly contrasts a doped metal oxide with a non-doped metal oxide. Neither Fig. 2 nor the description of Fig. 2 (at column 4, lines 55-58) indicate that a non-doped metal oxide is unsuitable. The Examiner contends that a teaching of non-preference is **not** tantamount to a teaching away, and **Ma et al** have explicitly allowed for the metal layer to be non-doped.

On page 12 of the Appeal Brief, Appellants allege that "Park teaches away from the use of evaporation." The Examiner disagrees; **Park** clearly discusses electron-beam evaporating substantially pure zirconium [see col. 4, lines 24-27]. While the Examiner concedes that evaporation deposition and sputtering are distinct processes with distinct characteristics, both are notoriously well known in the art for deposition of a single-metal layer. One of ordinary skill in the art would be motivated to employ whichever process suited the characteristics desired in the deposited layer.

Furthermore on page 12 of the Appeal Brief, Appellants argue that "Yano teaches away from pure metals and amorphous dielectrics, and thus does not cure the failure of the other references to suggest a pure metal." The Examiner again disagrees; as discussed above, **Yano et al** teach evaporation deposition of a single metal layer [while $Zr_{1-x}R_xO_2$ is preferred, it is taught that x may be 0, thus a single metal layer; see the Abstract] and oxidizing the metal [see col. 9, lines 1-6] and teach that the surface roughness is up to 0.6 nm across the surface. Furthermore, while it is true that **Yano et al** teach a preferred crystalline metal rather than an amorphous metal, **Yano et al** also

teach that it is known to make the metal amorphous. Furthermore, the instant specification teaches that the metal layer may be either amorphous or crystalline, with no criticality taught between the two types. The Examiner further submits that it is a mischaracterization to suggest that **Yano et al** was included in the rejection to "cure the failure of the other references to suggest a pure metal." Rather, **Yano et al** was cited by the Examiner to teach the smooth surface claimed by Appellants.

On page 14 of the Appeal Brief, Appellants allege that "[d]ependent claims 2 and 6-8 are held to be patentable at least as depending from patentable base claims as shown above." The Examiner submits that the independent base claims are not allowable, as described above; therefore, the rejection of the dependent claims stands.

Furthermore on pages 14-15 of the Appeal Brief, regarding the rejection of claims 8 and 9, Appellants argue the same alleged deficiencies of the combination of **Ma et al** with **Park** and **Yano et al**, furthermore stating that **Moise et al** "do not include the use of pure single metal layers and there is no motivation for one of ordinary skill in the art to make the proposed combine [*sic*] with Ma and the other references." The Examiner disagrees that the combination of **Ma et al** with **Park** and **Yano et al** is deficient, as explained above. Furthermore, the teachings of **Moise et al** are not intended to suggest the use of pure single metal layers, but rather to teach the inclusion of a krypton/oxygen plasma process.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Colleen E. Rodgers

Assistant Examiner

3 December 2008

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